OUTLINE OF SECTION C. ENVIRONMENTAL ASSESSMENT

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1. Environmental Fate

a. Environmental Fate Assessment

Surface and ground water contamination may occur from the *sulfoxide and sulfone degradates of phorate, as well as from parent phorate*. However, the risk of water contamination is *primarily associated with phorate sulfone and phorate sulfoxide* rather than parent phorate based on increased persistence and mobility for the degradates.

Phorate itself (*parent phorate*) is *not persistent* in the environment. It has been shown to degrade in soil by chemical and microbial action and to dissipate in the field with half-lives of 2 - 15 days. It is *moderately mobile* in soil, and has been shown to leach to a maximum depth of 6 inches in loamy sand and sandy loam soils. Phorate is subject to rapid hydrolysis with a $t_{1/2}$ of about 3 days. Due to the limited migration and the rapid hydrolysis, parent phorate is not expected to pose a significant risk to ground water. In contrast to phorate, the *phorate degradates*, phorate sulfoxide and phorate sulfone, are both *more persistent and more mobile* in the environment.

While phorate contamination of *surface water* by surface runoff may be an acute problem, the rapid hydrolysis will tend to lessen the concentration in a relatively short period of time.

The aerobic soil metabolism half-lives ($t_{1/2}$s) are 100 days (linear) and 54 days (non-linear) for the sulfoxide and 30 days (non-linear) and 15 days (linear) for the sulfone. The 30-day non-linear half-life may be underestimating the true half-life of phorate sulfone in soil because the lack of fit in the non-linear model (r^2=0.43). No meaningful linear fit for decline of the sulfone metabolite was possible because of limited decline intervals. However, the potential of these degradates to migrate in soil was demonstrated in a Georgia field dissipation study where phorate sulfone was found at 12-18 inches depth and phorate sulfoxide at 6-12 inches depth. There is a *potential for ground water contamination by parent phorate and the degradates phorate sulfone and phorate sulfoxide*. The Agency has no reports of detections of these degradates (or phorate parent) in ground water; however, the degradates have been analyzed for in only 12 samples. Because there has been very limited sampling for phorate degradates in ground water, *the current lack of detections does not mean that these degradates are not leaching to ground water.*

Surface water may be contaminated by phorate and phorate degradates. The degradates may be available for runoff for a longer period than parent phorate because they have a greater tendency to partition preferentially to water and are more persistent. Parent adsorption to permeable soils low in organic matter is low to moderate with Freundlich K_{ads} = 1.5 - 3.5. The anaerobic soil metabolism $t_{1/2}$ is 26.5 days.

Results of modeling with PRZM and EXAMS indicated that residues of phorate and the total toxic residues are expected to reach surface and ground water, with more residues of phorate sulfoxide and sulfone estimated to reach water than parent phorate.

Formaldehyde has been observed as a Phorate degradate in studies where hydrolysis is a major route of dissipation. This includes hydrolysis, aqueous photolysis, and the aerobic aquatic pond water studies.

b. Environmental Fate and Transport

(1) Degradation

Hydrolysis of Parent Phorate (161-1)--Phorate degraded with calculated half-lives of 2.6, 3.2, and 3.9 days in pH 5, 7, and 9 buffer solutions, respectively. The primary degradation product was formaldehyde, which increased until the end of the study (14 days). No OP metabolites were present at significant levels in the study. (MRID #41348507)

Hydrolysis of Parent Phorate and Phorate Sulfoxide and Sulfone (161-1)--The study was conducted using different temperatures for parent compound (10, 20, and 30 ºC) than those used for Phorate sulfoxide and sulfone. In addition, the registrant conducted the pH 5 and 7 studies for Phorate sulfoxide and sulfone at 40, 50, and 60 ºC and pH 9 metabolite studies at 20, 30, and 40 ºC. This study design generally indicates that the compounds degrade faster at higher temperatures, regardless of pH. (MRID 44863001)

EFED did not use this study for risk assessment since the registrant provided the aerobic aquatic pond water study (MRID 44863002, 162-4) described below. The aerobic aquatic pond water study provided useful inputs for the EXAMS model.

Photolysis in water (161-2)--Phorate degraded with a dark control adjusted half-life of 1.9 days in pH 7 buffer solutions after 7 days of continuous irradiation. Formaldehyde was the major non-OP degradate formed in the study. Phorate sulfoxide ranged from 7-27 % of applied parent phorate in no particular pattern in the study. (MRID #41348508)

Aerobic soil metabolism (162-1)--The registrant provided several aerobic soil metabolism studies for parent phorate and the metabolites. Two of these were literature studies (Getzwin and Shanks, J. Econ. Entom. 63:52-58; and Chapman et al., J. Econ. Entomol. 75:112-117, 1982). The other studies (MRID 42459401; 41131112; 40077301) were conducted according to guidelines and were considered to be acceptable in previous documents. These studies were used to assess the potential for parent phorate to reach surface and ground water. However, the results from these guideline studies were not used for modeling for surface or ground water in the current RED chapter. EFED normally uses the results of studies conducted according to guidelines for modeling purposes. However, since the guideline aerobic soil metabolism study was not carried out to enough time intervals to address the formation and decline of phorate sulfone, EFED used the data from the Getzwin and Shanks article as model inputs. EFED did not present the data from the other aerobic soil metabolism studies (MRID 40077301 and Chapman, et al., 1982) in the current RED Chapter, but notes that the other studies provided similar results for persistence and formation percentages of phorate sulfoxide and sulfone.

Phorate degraded in a Sultan silt loam soil with a half life of 15.8 days calculated using linear regression (log concentration against time), and with a half life of 8.3 days calculated by fitting the first-order degradation model using nonlinear regression, with untransformed concentration measurements. The 15.8-day half-life was originally calculated in previous documents, but EFED recalculated this half-life using non-linear regression because formation and decline analysis was used for modeling purposes. The major metabolites were Phorate sulfoxide, Phorate sulfone, and CO_2. Non-linear half-lives for these metabolites were 54.5 and 30.4 days, respectively, calculated using nonlinear regression. The maximum concentrations of these metabolites were 33, 24, and 22%, respectively. The results of this study were used for PRZM modeling because the formation and decline of the Phorate metabolites was addressed in a silt loam soil, which is the predominant soil texture used to support corn production. (Getzwin and Shanks, J. Econ. Entom. 63:52-58)

Anaerobic soil metabolism (162-2)--Phorate degraded with a linear anaerobic half-life of 26.5 days in nonsterile flooded silt loam soil that was incubated under a nitrogen atmosphere for 60 days following 9 days of aerobic incubation. No nonlinear regressions were conducted since formation and decline analysis was not possible. The phorate sulfoxide metabolite varied between 1.8 and 8.7 % of applied after anaerobic conditions, and therefore no half-life could be calculated. Parent Phorate was 21.4% of the applied dose after 60 days of anaerobic conditions. The major non-OP metabolite was CO_2, which increased to a maximum of 32.5% of the applied dose. No other metabolite increased to more than 3.3 % of applied. The volatile residues increased with time to 35.5% at 60 days. The soil-extractable and water residues decreased with increasing anaerobic time, and the soil residues were approximately 3-5X those of the flood water. Because the conditions were aerobic initially, the calculated anaerobic half-life is probably an underestimation of the true anaerobic soil half-life. (MRID #s 41936002; 41936002; 40077302)

Aerobic Aquatic Metabolism in Pond Water Only (162-4)–The pond water study is acceptable and provides useful information for modeling purposes. EFED used these data in EXAMS to determine the persistence of parent Phorate, Phorate sulfoxide, and Phorate sulfone, the formation rate of Phorate sulfoxide from applied parent, and the formation rate of Phorate sulfone from applied sulfoxide. Parent Phorate degraded with an aerobic aquatic half-life of 0.5 days (upper 10^{th} confidence bound on mean of two replicates) using non-linear analysis in nonsterile pond water that was incubated for 30 days. Parent Phorate reached non-detectable levels by 10 days. Applied Phorate sulfoxide degraded with a half-life of 9 days (upper 10^{th} confidence bound on mean of two replicates) and declined to 20.6 % of applied by 55 days in one replicate (end of study) and to non-detectable levels by 30 days. Applied Phorate sulfone degraded with a calculated half-life of 20.9 days (upper 10^{th} confidence bound on mean of two replicates) and declined to 35.2-38.2 % of applied by 30 days (end of study). The major metabolite of parent phorate was formaldehyde, which reached 24.5-25 % of applied by 2-3 days after treatment. Formaldehyde decreased to 13.1-16.6 % of applied by 14 days after treatment. Since formaldehyde formed at higher quantities than sulfoxide, this indicates that hydrolysis proceeded faster than metabolism that would produce sulfoxide and sulfone metabolites. However, formaldehyde was not formed in as great a quantity from applied sulfoxide and sulfone (<10 % of applied).

For the degradation of phorate sulfoxide to phorate sulfone, EFED added the residues of des-ethyl phorate sulfoxide to the phorate sulfone to determine the percent of toxic residues formed from applied phorate sulfoxide. (MRID #44863002)

(2) Mobility

The mobility information for parent Phorate and the sulfoxide and sulfone metabolites is presented below in Table 1. Parent Phorate is moderately mobile, and the sulfoxide and sulfone metabolites are more mobile than parent phorate.

		Adsorption Coefficients	
Chemical	Soil	K_{ads} (ml/g)	K_{oc}(ml/g)
Parent Phorate[1]	DE sand (0.4 % OC, pH 6)	1.8	450
	NJ sandy loam (1.8 % OC, pH 6.9)	4.0	224
	NE silt loam (1.3 % OC, pH 5.2)	5.6	434
	ONT loam (1.7 % OC, pH 7)	12	706
Phorate Sulfoxide[2]	Beulah sandy loam (0.29 % OC, pH 6.5, AR)	0.6	210
	Sassafras loamy sand (0.58 % OC, pH 6.9, NJ)	0.5	91
	Tippencanoe silt loam (1.8 % OC, pH 5.2, IN)	3.1	172
	Plano loam (1.4 % OC, pH 7.1, WI)	0.9	71
Phorate Sulfone[3]	Beulah sandy loam (0.29 % OC, pH 6.5, AR)	0.44	152
	Sassafras loamy sand (0.58 % OC, pH 6.9, NJ)	0.63	109
	Tippencanoe silt loam (1.8 % OC, pH 5.2, IN)	2.57	143
	Plano loam (1.4 % OC, pH 7.1, WI)	0.9	65

[1] The soil series information for the parent phorate study was not included because it was not immediately available (MRID 42208201). The adsorption of parent phorate was related to soil organic carbon content (r^2=0.39) and clay content (r^2=0.51), but not soil pH (r^2=0.02).

[2] The information for phorate sulfoxide was included in MRID 44671204. The adsorption of phorate sulfoxide was related to soil organic carbon content (r^2=0.67), clay content (r^2=0.45), and soil pH (r^2=0.97).
[3] The information for phorate sulfone was included in MRID 44671205. The adsorption of phorate sulfone was related to soil organic carbon content (r^2=0.74), clay content (r^2=0.55), and soil pH (r^2=0.95).

Soil Column Leaching Study (MRID 42208201)

The sulfone degradate was mobile in aged soil columns of loamy sand and sandy loam soils and was uniformity distributed in the column. Sulfoxide was found in the leachate at 12% and 3 %, respectively, in loamy sand and sandy loam soils. Parent did not move below 6 inches in the column. Parent appears to be moderately mobile in most mineral soils, but the degradates are more mobile than parent. Phorate sulfoxide is more mobile than phorate sulfone, and both degradates are more mobile than parent phorate. (MRID 42208201)

(3) Accumulation

The maximum accumulation in edible portions of fish was 326X. After 14 days depuration, approximately 90% of the residues were eliminated. (MRID 42701101)

(4) Field Dissipation

In general, parent phorate is not a persistent chemical; it degrades by chemical and microbial action and dissipates in the field with half-lives of 2 - 15 days. In a Georgia field dissipation study on sandy loam soil (MRID 42547701) parent did not move below 6 inches in soil, but phorate sulfone was found at 12-18 inches depth and phorate sulfoxide was found at 6-12 inches depth. The total toxic residue half-life (parent +sulfoxide+sulfone) was 17 days (non-linear) and 48 days (linear). In an Illinois study on silt loam soil (MRID 40586506) a comparable half-life of 9 - 15 days was observed for parent phorate. The total toxic residue half-life in Illinois was 108 days (non-linear) and 117 days (linear). No leaching of either the parent of degradates below 6 inches was observed. in the Illinois study. (MRID 40586500)

(5) Laboratory Volatility

Maximum volatility rates of 7.5 - 13.3 ug/cm^2/hr were observed at 3 days with corresponding maximum air concentrations of 530 - 1400 ug/m^3 from soil moistures of 50 and 75% FMC and flow rates of 100 and 300 mu/min. Phorate was 68 -71% of the applied material in the foam plug extracts at 14 days post treatment. Phorate sulfoxide was <5% in the foam plug extracts and phorate sulfone was present at <0.3%. In the soil extracts plus flask rinsates phorate was measured at 14.2 - 27.5% of the applied and the degradates, phorate sulfoxide and phorate sulfone, were measured at 3.1 - 6.4 and 0.7 - 4.5% respectively. (MRID 42930301)

3. Water Resources

Environmental fate properties of phorate and phorate degradates, reviewed above in the Environmental Fate Assessment, suggest that *surface water* contamination may occur from the *sulfoxide and sulfone degradates of phorate, as well as from parent phorate*. The risk of *ground water* contamination is *primarily associated with phorate sulfone and phorate sulfoxide* rather than parent phorate. This section provides evaluation of available monitoring information and modeling results estimating environmental concentrations, for *parent phorate*, for use in assessing dietary exposure and exposure to aquatic nontarget organisms. The information available on fate properties of phorate degradates is not sufficient for modeling concentrations in ground and surface water. (In particular, the Agency does not have values for mobility constants (K_{oc}'s) for the principal degradates.)

a. Surface Water

Phorate Occurrence in Surface Water. The State of Illinois (Moyer and Cross 1990) sampled 30 surface water sites for pesticides at various times from October 1985 through October 1988. Although substantial use in Illinois was a criteria for pesticides being included in the analyses, total phorate (parent phorate + phorate sulfoxide + phorate sulfone) was not detected in any of the samples above a detection limit of 0.05 ug/L.

The USGS (Kimbrough and Litke 1995) has sampled the South Platte River in Colorado, Western Lake Michigan, and the Albemarle-Pamlico River in Virginia and North Carolina for parent phorate. With a detection limit of 0.002 ug/L, detected residues of parent phorate ranged from 0.009-0.082 ug/L except for one detection of 0.6 ug/L in the South Platte. These watersheds are locations where corn, grain sorghum, and sugar beets are grown. EFED counted 104 samples. USGS monitoring is designed to measure water quality in a watershed with an area of 10-2,000 square miles that is associated with specific chemical use. It is not specifically designed to measure drinking water exposure. Degradates were not analyzed for.

The USGS (Coupe et al., 1995) sampled 8 widely dispersed locations in the Mississippi Basin from April 1991 through September 1992. Samples were collected once per week, twice per week, or once every two weeks depending upon the time of year. The samples were filtered before analysis. Parent phorate (dissolved) was not reported in any of the 360 samples (detection limit of 0.011 ug/L) for which an analysis for phorate was performed. Degradates were not analyzed for.

The South Florida Water Management District (Miles and Pfeuffer 1994) collected samples every two to three months from 27 surface water sites within the SFWMD from November 1988 through November 1993. Approximately 810 samples (30 sampling intervals X 27 sites sampled/interval) were collected from the 27 sites from November 1988 through November 1993. Phorate was not detected in any of the samples above detection limits ranging from 0.016 to 0.13 ug/L.

Monitoring for phorate residues in surface water does not usually include the phorate sulfoxide and sulfone degradates. Also, there is limited monitoring information for all phorate residues in surface water.

Tier II Estimated Surface Water Concentrations. Tier II estimated environmental concentrations (EECs) have been calculated for parent phorate and for total toxic residues of parent phorate. A Tier II EEC for a particular crop or use is based on a single site that represents a high exposure scenario for the crop or use. Tier II EECs are used to assess drinking water exposure and exposure to aquatic organisms for surface water. (These results are used as the basis of exposure estimates for dietary risk assessment displayed in the Drinking Water Assessment below.)

- Table 2 below gives persistence and mobility inputs used in calculating EECs.

- Table 3 below gives EECs estimated using the PRZM (Version 3.12) and EXAMS (Version 2.975) models.

To calculate a Tier II EEC, weather and agricultural practices are simulated at the site for 36 years to estimate the probability of exceeding a given concentration (maximum concentration or average concentration) in a single year. Maximum EECs are calculated so that there is a 10% probability that the maximum concentration in a given year will exceed the EEC at the site; 4-day, 21-day, 60-day, and 90-day EECs are calculated so that there is a 10% probability that the maximum average concentration for a given duration (4-day, 21-day, etc.) will equal or exceed the EEC at the site. Maximum EECs can also be considered to represent a 1-in-10-year exceedance.

EFED estimated drinking water concentrations for phorate applied to field and sweet corn, peanuts, cotton, potatoes, and grain sorghum. The simulated application techniques included t-banded, in-furrow at planting and side-dress application once the applicable crop had emerged. These crops represented the maximum application rates and primary crops to which phorate is applied, and give the maximum EECs for applied phorate. EFED did not run the sugarcane scenario because the label specifically states that this use is for Florida. Florida sugarcane is grown primarily around Lake Okechobee, and the water levels in the fields are managed by flooding canals. Therefore, it is impossible to properly simulate this scenario because of fluctuating water levels. In previous RED Chapters, EFED ran sugarcane in Louisiana , but is no longer using this scenario for phorate in sugarcane. EFED also did not run winter wheat (North Dakota), soybeans (Iowa), dried beans (Michigan), and potatoes in Maine in the current RED Chapter. Winter wheat produced relatively low EECs as compared to other crops. Soybeans and dried beans are relatively minor uses compared to other crops, and phorate is not used significantly in Maine for potatoes. Also, EFED is now using an Ohio field corn scenario instead of the Iowa field corn scenario used in previous RED Chapters.

For field corn, sweet corn, and grain sorghum two applications per year are allowed by the labels. EFED only modeled the at-plant application, based on the fact that the 9/16/97 fax from John Wrubel of Cyanamid stated that "greater than 95% of phorate applied to each these crops is applied at planting." Simulating two applications per year will not qualitatively effect the ecological level of concern exceedances.

Comparison of Modeling and Monitoring. Maximum concentrations of parent phorate estimated using PRZM-EXAMS ranged from 4.6 ug/L for field corn in Ohio to 27.6 ug/L for cotton in Mississippi. In surface water bodies with dilution the actual concentrations would likely be lower. The estimated chronic concentrations for all modeled crops ranged from 0.04-1.6 ug/L. Parent phorate was not found above 0.6 ug/L in surface monitoring data from Colorado, and most monitoring does not address the sulfoxide and sulfone metabolites. Therefore, EFED recommends using the total toxic residue EECs from PRZM-EXAMS modeling for drinking water estimates.

EFED simulated only the banded or lightly-incorporated applications of phorate, with the exception of potatoes, for which phorate is applied in-furrow. EFED did this because the PRZM-EXAMS model is likely underpredicting residues off the field when the pesticide is applied below 1 inch of soil depth. PRZM does not move pesticides upward from a fixed depth even though this can occur in the field in finer-textured soils through capillary action.

Table 2. Environmental Fate Parameters used in PRZM-EXAMS Modeling for Parent Phorate, Phorate sulfoxide, and Phorate sulfone.

Parameter	Value	Source (MRID unless specified)	Uncertainty Factor[1]	Rate Constants (K-value)
Parent Phorate				
Freundlich K_{ads}	4.04 ml/g	42208201	Not Applicable	Not Applicable
Aerobic Soil Metabolism $T_{1/2}$	8.27 days[2]	Getzwin and Shanks	None	8.40×10^{-2} day^{-1}
Aerobic Aquatic Metabolism $T_{1/2}$	0.457 days[3]	44863002	None	1.9×10^{-2} $hour^{-1}$
Anaerobic Aquatic Metabolism $T_{1/2}$	Not Applicable	None	None	0 $hour^{-1}$
Phorate sulfoxide				
Freundlich K_{ads}	0.53 ml/g/	44671204	Not Applicable	Not Applicable
Aerobic Soil Metabolism $T_{1/2}$	54.5 days[2]	Getzwin and Shanks	None	1.27×10^{-2} day^{-1}
Aerobic Aquatic Metabolism $T_{1/2}$	9.06 days[3]	44863002	None	3.19×10^{-3} $hour^{-1}$
Anaerobic Aquatic Metabolism $T_{1/2}$	Not Applicable	None	None	0 $hour^{-1}$
Phorate Sulfone				
Freundlich K_{ads}	0.90 ml/g	44671205	Not Applicable	Not Applicable
Aerobic Soil Metabolism $T_{1/2}$	30.35 days[2]	Getzwin and Shanks	None	2.30×10^{-2} day^{-1}

Aerobic Aquatic Metabolism $T_{1/2}$	20.9 days[3]	44863002	None	1.38×10^{-3} hour^{-1}
Anaerobic Aquatic Metabolism $T_{1/2}$	Not Applicable	None	None	0 hour^{-1}

[1] For laboratory metabolism studies, EFED normally multiplies a single metabolism study $T_{1/2}$ by 3 to account for the uncertainty of having only one half-life. Since EFED conducted a formation and decline analysis, no uncertainty factors were included, and the value given in Column 2 has been used in PRZM-EXAMS modeling, after conversion to a rate constant (Column 5).

[2] EFED used the lowest non-sand Kd values for each species, since adsorption was not significantly correlated with % organic carbon.

[3] $T_{1/2}$ values used for PRZM-EXAMS modeling were calculated by fitting the first-order dissipation model using nonlinear regression with untransformed concentration measurements. For the KBACS (pond sediment) rate value in EXAMS, EFED assumed no degradation, due to an absence of adequate anaerobic data.

[4] Since the aerobic aquatic metabolism study included two replicates of each treatment, EFED calculated a 90% upper confidence limit on the mean $T_{1/2}$ for the two replicates. EFED then converted these half lives to rate constants, and used them as inputs into the model.

Table 3. EECs for Surface Water Including Parent Phorate only and for Total Toxic Residues of Parent Phorate, Phorate Sulfoxide, and Phorate Sulfone.

Crop and Application Method	Parent only or Total toxic residue	EECs (ug/L)					
		Peak	4-Day	21-Day	60-Day	90-Day	Annual Mean
Sweet Corn T-banded at 1.3 lb ai/A (85 % in top 2 cm) [1]	Parent	21.3	13.6	3.3	1.2	0.8	0.2
	TTR	26.9	18.6	8.2	5.9	4.5	1.2
Peanuts (1.64 lb ai/A at plant in- furrow and 2.9 lbs a/A side- dressed 90 days prior to harvest	Parent	18.1	9.0	2.0	0.7	0.5	0.1
	TTR	25.2	16.0	8.8	4.7	3.4	0.9
Cotton (In-furrow at 0.5 inch)	Parent	23.1	13.2	3.9	1.4	0.9	0.2
	TTR	27.6	21.0	12.4	8.2	6.1	1.6
Potatoes in Idaho in-furrow (all at 2 inches of depth)	Parent	0	0	0	0	0	0
	TTR	0	0	0	0	0	0
Field Corn T-banded at 1.3 lb ai/A (85 % in top 2 cm) [1]	Parent	4.6	2.5	0.7	0.2	0.2	0.04
	TTR	7.7	5.7	3.9	2.5	1.8	0.5
Grain Sorghum T-banded at 1.3 lb ai/A [1] (85 % in top 2 cm)	Parent	7.5	4.1	1.2	0.4	0.3	0.07
	TTR	12.7	9.5	7.1	4.2	3.0	0.85

[1] Simulations for sweet corn, field corn, and grain sorghum have assumed a single application per year, while labels permit two is conducting simulations that assume 2 applications per year for these crops.

b. Ground Water

Occurrence of phorate in ground water. Review of environmental fate properties suggests that there is a p contamination by the degradates phorate sulfone and phorate sulfoxide. The Agency has no reports of detecti (or phorate parent) in ground water; however, the degradates have been analyzed for in only 12 samples. Be limited sampling for phorate degradates in ground water, *the current lack of detections does not mean that th leaching to ground water.*

A number of insecticides, including phorate, have been included as analytes in ground-water monitoring studie state, or local agencies and chemical companies. Many of these studies are summarized in the Pesticides in G (PGWDB; Hoheisel, 1992). The PGWDB reports that parent phorate has not been detected in 3,341 ground- summarized, which is consistent with the results of the laboratory and field dissipation studies. There were nc degradates phorate sulfoxide and sulfone in 12 samples and phoratoxon sulfone and phoratoxon sulfide in 9 sa California (USEPA, 1992). Fate data indicate that the degradates would likely be detected in vulnerable grou sampling were conducted. Phorate sulfoxide was detected at 6-12 inches depth and phorate sulfone at 12-18 i terrestrial field dissipation study in Georgia with permeable soils and normal rainfall.

Estimated concentrations in ground Water (SCI-GROW). The table below displays estimates of parent p based on the SCI-GROW model (Barrett, 1997). (These results are also used in estimating concentrations fo assessment as described in the Drinking Water Assessment below.)

SCI-GROW (Screening Concentrations in Ground Water) is a model for estimating "upper bound" concentrat ground water. SCI-GROW calculations are based on application rates, scaled ground water concentrations fr monitoring studies, and environmental fate properties (aerobic soil half-lives and organic carbon partitioning c GROW provides a screening concentration; an estimate of likely ground water concentrations if the pesticide i allowed label rate in areas with ground water exceptionally vulnerable to contamination (soils vulnerable to le at 10-30 feet). In most cases, a majority of the use area will have ground water that is less vulnerable to conta used to derive the SCI-GROW estimate.

For total toxic residues of phorate, SCI-GROW results predict that maximum acute and chronic concentratior will not exceed 13.5 ug/L for the labeled use sites at the highest rate (4.5 lbs ai/A). Estimated concentrations ug/L (Table 4 below). The estimated concentrations in ground water will be proportionally lower in relation t because of the linear relationship between application rates and SCI-GROW estimates. Table 5 contains the i model for each crop.

Comparison of modeling and monitoring results for ground water. Results obtained using SCI-GROW ir concentrations in ground water of 13.5 ug/L for total toxic residues of phorate. There are very limited data (1 the ground water levels against, and therefore, the lack of detections cannot be compared to the modeling. Tl the SCI-GROW modeling numbers instead of the monitoring, since almost all of the samples were for parent (detections of parent phorate in 3,341 samples in the Pesticides in Ground Water Database (PGWDB). This re results of field dissipation studies which indicated negligible downward mobility in soil.

Based on environmental fate data, EFED predicts that the more persistent degradates may be found at higher l than parent phorate.

Table 4. Acute and Chronic Estimated Environmental Concentrations[1] of Total Toxic Residues of Phorate Rates) in Ground Water using the Tier 1 Model SCI-GROW.

Crop	Rate (lbs ai/A)	Acute and Chronic EE(
Corn	2.6	7.8
Grain Sorghum	2.6	7.8
Soybeans	2.0	6.0
Sugar Beets	3.0	9.0
Sugarcane	3.9	11.7
Wheat	1.0	3.0
Peanuts	4.5	13.5
Potato	3.5	10.5

Beans	2.0	6.0
Cotton	3.8	11.4

[1] SCI-GROW is a Tier 1 model that does not provide different values for acute and chronic EECs. Therefore, the same exposure both acute and chronic risk assessment.

Table 5. Input Values for SCI-GROW for Total Toxic Residues of Phorate.

Crop	Maximum Annual Rate (lbs ai/A)	Number of Applications[1]	Koc[2] (ml/g)	Aer
Corn	2.6	1	65	
Grain Sorghum	2.6	1	65	
Soybeans	2.0	1	65	
Sugar Beets	3.0	1	65	
Sugarcane	3.9	1	65	
Wheat	1.0	1	65	
Peanuts	4.5	1	65	
Potato	3.5	1	65	
Beans	2.0	1	65	
Cotton	3.8	1	65	

[1] Since SCI-GROW only takes into account the total amount of applied pesticide in a year and not the timing of appli
reviewer used only one application in the model.

[2] The lowest K_{oc} from both the sulfoxide and sulfone metabolites was used since the adsorption of these metabolites w
(r^2=0.98 for sulfoxide and 0.95 for sulfone).

[3] The 122-day half-life was calculated by adding the parent phorate, phorate sulfoxide, and phorate sulfone residues f
metabolism study (MRID 4077301) and running linear regression (r^2=0.94) on the log of the summed residues.

c. Drinking Water Assessment

Surface water concentrations for drinking water exposure assessment. Table 3 above contains surface v total toxic residues of phorate for use in a dietary risk assessment, based on modeling with PRZM Version 3.1 2.975. Parent phorate concentrations were provided for comparison purposes only.

Limitations of Tier II Surface Drinking Water Assessment. Obviously, a single 10 hectare field with a 1 l accurately reflect the dynamics in a watershed large enough to support a drinking water facility. A basin of th be planted completely to a single crop nor be completely treated with a pesticide. Additionally, treatment witl likely occur over several days or weeks, rather than all on a single day. This would reduce the magnitude of but also make them broader, reducing the acute exposure but perhaps increasing the chronic exposure. The fa has no outlet is also a limitation as water bodies in this size range would have at least some flow through (rive (reservoirs).

In spite of these limitations, a Tier II EEC can provide a reasonable upper bound on the concentration found i accurate assessment of the real concentration. The EECs have been calculated so that in any given year, there the maximum average concentration of a given duration will equal or exceed the EEC. Tier II values can reas screens to demonstrate that the risk is below the level of concern.

Ground water concentrations for drinking water exposure assessment. Table 4 above contains ground w total toxic residue of phorate for use in a dietary risk assessment, based on modeling with SCI-GROW.

Uncertainties in estimating ground water concentrations. The SCI-GROW model is based on small-scale studies conducted on highly vulnerable sandy soils with shallow ground water (10-30 ft in depth). Uncertainti model are: 1) The model does not consider site specific factors regarding hydrology, soil properties, climatic c practices; 2) The model does not account for volatilization, and 3) Predicted ground water concentrations are the application rates. This model is based on actual field data from “upper bound” ground water monitoring s sandy soils and with heavy irrigation. Therefore the results should be considered to be an "upper bound" for p ground water.

4. Ecological Toxicity Data

a. Toxicity to Terrestrial Animals

(1) Birds

Acute and subacute toxicity. An acute oral toxicity study using the technical grade of the active ingredient i toxicity of a pesticide to birds. The preferred test species is either mallard duck or bobwhite quail. Results of below.

Avian Acute Oral Toxicity

Species	%A.I.	LD50 mg/kg (95% confidence limits)	Toxicity Category	MRID No. Author/Year
Mallard Duck	96.8	0.62 (0.37-1.03)	very highly toxic	160000 Hudson 1984
Ring necked Pheasant	98.8	7.12 (4.94-10.3)	very highly toxic	160000 Hudson 1984
Starlings	Tech.	7.5	very highly toxic	20560 Schafer 1972
Redwing Blackbird	Tech.	1	very highly toxic	20560 Schafer 1972
Grackle	Tech.	1.3	very highly toxic	20560 Schafer 1972
Mallard Duck	88	2.55 (2.02-3.21)	very highly toxic	160000 Hudson 1979
Chukar	98.8	12.8 (3.2-51.2)	highly toxic	160000 Hudson 1984

[1] Study classification is divided into three categories: "Core" which indicates that the study fulfills guideline requirements, "Supplemental" which indicates that the study fulfill guideline requirements, and "Invalid" which indicates the study is neither scientifically sound nor does it fulfill guideline requirements. "Invalid" studies are not in in this RED.

The results indicate that phorate is very highly toxic to avian species on an acute oral basis. The guideline req (MRID Nos 160000 & 20560). Although no one study is fully acceptable, the consistency of the results indic warranted.

Hudson (1984) described several behavioral indications of intoxication in mallards at 0.09 mg/kg, which is a dose used in risk quotient calculations. Symptoms were observed as soon as 3 minutes after treatment (by ga between 10 minutes and 4 hours after treatment, and remission required up to 2 days.

Two dietary studies using the technical grade of the active ingredient are required to establish the toxicity of a preferred test species are mallard duck (a waterfowl) and bobwhite quail (an upland gamebird). Results of the below.

Avian Dietary Toxicity

Surrogate Species	% A.I.	LC_{50} ppm (95% Confidence Limits)	Toxicity Category	MRID No. Author/ Year	Study Classification
Northern Bobwhite	90	373 (326-431)	highly toxic	00022923 Hill 1975	Core
Ring-necked Pheasant	90	441 (381-510)	highly toxic	00022923 Hill 1975	Core
Mallard	90	248 (198-306)	highly toxic	00022923 Hill 1975	Core

These results indicate that phorate is highly toxic to avian species on an dietary basis. The guideline requireme (MRID No. 00022923).

Chronic toxicity. Avian reproduction studies using the technical grade of the active ingredient are required f present product labeling allows several applications of the end-use product per growing season. Results of th below.

Avian Reproduction

Surrogate Species[1]	% A.I.	NOEL (ppm)	Affected Endpoint	MRID No. Author/ Year	Study Classification
Northern Bobwhite Quail	92.1	>60	None	158333 Beavers/ 1986	Supplemental
Mallard Duck	92.1	5	Eggs laid, Viable embryos, Normal hatchlings	0158334 Beavers/ 1986	Core

The acceptable mallard study shows the ability of adult mallards to lay eggs, to produce viable embryos and tc significantly inhibited when they are fed 60 ppm of the technical phorate, 92.1% a.i., for 19 weeks. The guide partially fulfilled by the quail study due to poor egg production in the controls. However, it is not likely the qu the mallard. Therefore, another study is not requested. The guideline requirement (71-4) is fulfilled (MRID #

(2) Mammals

Wild mammal testing is required on a case-by-case basis, depending on the results of lower tier laboratory mar use pattern and pertinent environmental fate characteristics. In most cases, rat or mouse toxicity values based health effects studies substitute for wild mammal testing.

An acute oral LD_{50} of 1.4-3.7 mg/kg for rats indicates that phorate is *very highly toxic to small mammals on a* dietary LC_{50} was found to be 28 ppm for the Albino Norway Rat. Also relevant to the risk to wildlife is signif (Dermal LD_{50} 3.9 to 9.3 mg/kg in rats). Additional support for high dietary toxicity is provided by two 90 da and a 105 day feeding study with dogs, with cholinesterase inhibition as the measurement endpoint.

The 90 day feeding studies with phorate and phorate sulfoxide show cholinesterase differences from the contr concentrations, the NOAELS are 0.66 ppm and 0.32 ppm, respectively. The Agency has not adopted descript

the results of mammalian chronic studies. The human health section of the RED provided insight into the abo
feeding study:

The health effects data indicated that "Phorate can be metabolized to more potent anticholinesterase compoun desulfuration and/or sulfide oxidation. These processes would produce phorate oxygen analog, phorate sulfo: analog sulfoxide, phorate sulfone, and phorate oxygen analog sulfone."

(3) Insects

A honeybee acute contact study using the technical grade of the active ingredient is not required for granular f studies have been submitted. The following table tabulates the available bee studies.

Nontarget Insect Acute Toxicity

Surrogate Species	% A.I.	LD_{50} (g/bee)	Toxicity[1] Category	Author/ Year
Honeybee	Tech.	0.32	Highly toxic	Steveson/1978
	Tech.	10.07	Moderately toxic	Atkins/1975

The results indicate that phorate is moderately to highly toxic to honeybees on an acute contact basis. These s requirement (141-1) (MRID 05001991; 00036935).

Exposure to honeybees is expected to be minimal for a granular pesticide. However, a variety of beneficial ir with soil, including Hymenoptera other than honeybees.

(4) Terrestrial Field Testing and Incidents

Simulated Field Studies. Small pen studies are simulated field studies with cages (pens) of birds and /or mar crop.

• Four pen studies have been conducted to evaluate the effect of phorate on bobwhite quail. Because this typ all of the species and stresses associated with a particular use site the amount of useful information is limited. from these bobwhite quail studies are of interest to the risk assessment.

1. Thimet 20G was applied to both irrigated and non-irrigated corn. Mortality occurred on all treated plots (

2. Although the quail is not as sensitive to phorate as the mallard duck, red winged blackbird, or common gra with quail showed mortality.(MRID Nos. 00074623; 0074624; 00074625; 00074626)

3. Both whorl and soil application resulted in adverse effects. (MRID Nos. 00074623; 0074624; 00074625;

• A littoral mesocosm field study was conducted in the Prairie Pothole Region of South Dakota. Three meso both the upland and wetland portions of the mesocosm with phorate at the following rates: 1, 2, and 4.3 lbs a. were the surrogate species. The ducklings died at all three treatment levels. In the second year of the study 1 restocking on days 2-3 post-treatment due to high mortality. (MRID No. 43819501)

Field Studies. A field study was conducted using phorate on corn with at-plant, at-cultivation, and aerial appl of the study was limited because the researchers did not sufficiently search the treated areas. Even so, the stu granules kill birds and mammals. Among the killed and poisoned species found were a peacock, raccoon, indi short-tailed shrews, and starlings. Residue analysis indicated that phorate and its degradates were sufficient to mammals for two to three weeks after application, at least for aerial application methods and possibly for appl procedures as well. (MRID No. 40165901)

Terrestrial Incidents (see also Appendix 2 for Table of Incidents). A number of terrestrial incident reports a with the field studies, these indicate that the use of phorate will result in adverse effects. The incidents demor range of vertebrate species. The incidents are discussed further in the risk characterization.

The incident information suggests that poisoning of wildlife by phorate and/or phorate degradates may occur application. Fall applications in cool climates may pose a particular hazard. In particular, there are three incic avian risk associated with fall applications for winter wheat, with no indications of misuse or very limited indic these, two occurred months after application:

- B000150-015 (Hughes County S. Dakota) involved over 100 birds (primarily waterfowl and raptors.) March following a September application.

- Reports associated with incident number B000150-008 appear to represent two incidents associated w Dakota, of which only one (in Potter County) is attributable to misuse. The incident occurred in Lyman Cour

- B000150-016 involved mortality in the January following a November application to wheat in Georgia misuse for that incident are minimal: Phorate was applied to soil that was too wet for adequate soil coverage c

The incident that has been the subject of most attention and research has been B000150-015. On March 26, birds on a winter wheat field in Hughes County, SD, 10 miles north of Pierre, that was treated on September rate of 1.2 oz/1000 foot row with a 10-inch row spacing. The incident report did not specify the application r the granules were incorporated. If label instructions were followed, the granules would have been applied in-

During late winter to early spring, a pond had formed in the wheat field from the thaw of the snow cover and and 17, 1989. On March 29, 1989, 70 Canada geese and other waterfowl were found dead around this tempo later, 12 Canada geese, ducks and a sharp-tailed grouse were found dead in a second small pond about one-th pond. On March 19, eagles had been observed at one of these ponds feeding on dead geese. Seven bald eagle eagle are believed to have been fatally poisoned by phorate in this manner. Phorate residues were measured i 0.025 ppm in the pond water samples.

Analysis by the Fish and Wildlife Service detected phorate metabolites but not parent phorate in some tissue s results for one eagle carcass was exceptional in having parent phorate at a high concentration relative to conc metabolites, in the gastrointestinal (GI) tract. Also the eagle GI tract contained a goose GI tract with parent p concentration. American Cyanamid has argued that the goose was mostly killed by ingesting undegraded phor killed by feeding on the goose carcass (J. Gagne to M. Mautz, Dec. 3, 1990). Cyanamid maintains that expos March could not result from an application in September given the degradation rate of parent phorate. Before conclusion based on the FWS study, EFED would need to review all of the residue information available for t

The Gagne-Mautz memo also reports that a piece of a THIMET bag was found about 150 yards from the poc
carcasses were found, indicating some improper disposal of bags in the area. However, this does not establish
to improper disposal.

EFED finds that Cyanamid's argument does not refute the use of the incident as a whole as an indication of ad
corresponding to normal use. Primarily, this is because the results apply to only two of a large number of care
carcasses the results are consistent with the conclusion that an incident resulted from normal use. In addition,
regarding the dissipation of phorate residues in fall-winter conditions in South Dakota.

b. Toxicity to Aquatic Animals

(1) Freshwater Fish

Acute toxicity findings. Two freshwater fish toxicity studies using the technical grade of the active ingredien
the toxicity of a pesticide to fish. The preferred test species are rainbow trout (a cold-water fish) and bluegill
fish). Results of these tests are tabulated below.

Freshwater Fish Acute Toxicity

Surrogate Species	**% A.I.**	**LC_{50} (ppb)**	**Toxicity Category**	**MRID No. Author/Year**
Rainbow trout *(Onchorynchus mykiss)*	100	13	Very highly toxic	40094602/ Johnson & Finley/ 1980
Bluegill sunfish *(Lepomis macrochirus)*	100	1	Very highly toxic	40098001/ Mayer & Ellersieck/ 1986

The results indicate that phorate is very highly toxic to freshwater fish on an acute basis. The guideline requir
(MRID Nos. 40094602 & 40098001)

Chronic toxicity findings. A fish early life stage test is required for phorate because LC_{50} is < 1 mg/kg and that phorate (6.8 and 32.2 ppb) was present in a pond where fish died. Results of this test are tabulated below

Freshwater Fish Early Life-Stage Toxicity

Surrogate Species	% A.I.	NOEC/LOEC (ppb)	MATC (ppb)	Endpoints Affected	MRID No. Author/Year
Rainbow trout *(Onchorynchus mykiss)*	92.1%	1.9/4.2	2.6 µg/L	Total length	158335/ Surprenant/ 1986

The guideline requirement (72-4a) is fulfilled (MRID #158335). The NOEC, MATC, and LOEC are very low concentrations are needed to effect growth.

A full life cycle study is not required. The rainbow trout early life stage NOEC was used to estimate an NOE The resultant risk quotients exceed the chronic effects LOC. Although the full life cycle study is expected to LOCs are exceeded with the short term study.

(2) Freshwater Invertebrates

Acute toxicity findings. A freshwater aquatic invertebrate toxicity test using the technical grade of the activ assess the toxicity of a pesticide to invertebrates. The preferred test species is *Daphnia magna*. Results of th below:

Freshwater Invertebrate Acute Toxicity

Surrogate Species	% A.I.	LC_{50}/ EC_{50} ppb (confidence limits)	Toxicity Category	MRID No. Author/Year
G.fasciatus	Tech	0.68 (0.36-1.0) 0.60 (0.3-0.8)	Very highly toxic	05017538 Sanders/1972
G.fasciatus	Tech	9(5.1-13)	Very highly toxic	0097842 Sanders/1969
G.fasciatus	Tech	4(2-7)	Very highly toxic	0003503 Johnson/1980
Pteronarcys	100	4(2-6)	Very highly toxic	0003503 Johnson/1980
Orconectes nais	Tech	50 (30-75)	Very highly toxic	05017538 Sanders/1972
			Formulation Testing[1]	
Daphnia magna	20% (Thimet 20G)	37(30-44)	Very highly toxic	0161825 Nicholson/ 1986
Midge larvae *(Paratanytarsus parthenogenica)*	20% (Thimet 20G)	41(38-45)	Very highly toxic	0161826 Nicholson/ 1986
Mayfly nymphs (*Hexagenia sp.)*	20% (Thimet 20G)	65 (47-74)	Very highly toxic	0161827 Hoberg 1986

[1] The LC50 values are expressed as concentration of formulated product.

The results indicate that both the technical grade and 20% product of phorate are very highly toxic to aquatic basis. The guideline requirement (72-2) is fulfilled MRID Nos. 05017538, 0097842, & 0003503). Although, acceptable alone, the consistency of the results indicates no further testing is warranted.

Chronic toxicity findings. An aquatic invertebrate life-cycle test is required for phorate because 1) the lowe and 2) and monitoring data indicate that phorate (6.8 to 32.3 µg/L) was present in a pond where fish were kill are tabulated below.

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Surrogate Species	% A.I.	NOEC/ LOEC (ppb)	MATC (ppb)	Endpoints Affected	MRID No. Author/Year
Daphnid *(Daphnia magna)*	100	0.21/0.41	0.29	Number of offspring per female and growth of parental daphnids	42227102 Yurk, J.J./1991

The NOEC, MATC, and LOEC are very low and indicate minimal concentrations are needed to effect reproc guideline requirement (72-4) is fulfilled (MRID No. 42227102).

(3) Estuarine and Marine Animals

Acute toxicity findings. Acute toxicity testing with estuarine/marine organisms (fish, shrimp and oyster) usin the active ingredient is required when an end-use product is intended for direct application to the marine/estua active ingredient is expected to reach this environment because of its use in coastal counties. The preferred te minnow, mysid and eastern oyster. Estuarine/marine acute toxicity testing is required for phorate because the expected to be transported to estuarine waters. Results of these tests are tabulated below.

Estuarine/Marine Acute Toxicity for Phorate Technical

Surrogate Species	**% A.I.**	**LC_{50}/EC_{50} (confidence limits) ppb**	**Toxicity Category**	**MRID No. Author/ Year**
Eastern oyster embryo-larvae *(Crassostrea virginica)*	89.5	900 (400-1900)	Highly toxic	40228401 U.S.EPA/ 1981
Mysid *(Americamysis bahia)*	89	1.9(1.0-3.2)	Very highly toxic	40228401 U.S.EPA/ 1981
Mysid *(Americamysis bahia)*	90	0.33(0.27-0.43)	Very highly toxic	40228401/ U.S. EPA/ 1981
Penaeid shrimp	89.5	0.27(0.18-0.32)	Very highly toxic	40228401 U.S.EPA/ 1981
Pink shrimp	89.5	0.11(0.08-0.160)	Very highly toxic	40228401 U.S.EPA/ 1981
Spot	89.5	5.0(4.2-5.6)	Very highly toxic	40228401 U.S.EPA/ 1981
Spot	89.5	3.9(3.1-5.6)	Very highly toxic	40228401 U.S.EPA/ 1981
Sheepshead minnow	89.5	1.3(0.97-1.7)	Very highly toxic	40228401 U.S.EPA/ 1981
Longnose Killifish	90	0.36	Very highly toxic	40228401/ U.S.EPA/ 1981
Sheepshead	89.5	4.0(3.5-4.5)	Very highly toxic	40228401

Estuarine/Marine Acute Toxicity for Formulated Phorate

Surrogate Species	% A.I.	LC_{50}/EC_{50} (confidence limits) ppb	Toxicity Category	MRID No. Author/ Year
Quahog clam	Thimet 20G (20% a.i.)	17(4.4-71)	Very highly toxic	40004201/Supre
Sheepshead minnow *(Cyprinodon variegatus)*	Thimet 20G (20% a.i.)	8.2(5.5-10)	Very highly toxic	40001801/ Suprenant/1986
Mysid *(Americamysis bahia)*	Thimet 20G (20% a.i.)	0.3(0.26-0.35)	Very highly toxic	41803804 Sousa/ 1990

The results indicate that technical grade and 25% product of phorate are very highly toxic to estuarine/marine an acute basis. The guideline requirement (72-3a) is fulfilled (MRID # 40228401 and 41803804).

Chronic toxicity findings. Estuarine/marine fish early life-stage and aquatic invertebrate life-cycle toxicity te phorate because (1) the pesticide is intended for use such that its presence in water is likely to be continuous o toxicity; (2) acute LC_{50} and EC_{50} are less than 1 mg/L; (3) the EEC in water is equal to or greater than 0.01 of values; or (4) the actual and estimated environmental concentration in water resulting from use is less than 0.0 LC_{50} value and studies of other organisms indicate the reproductive physiology of invertebrates may be affecte persistent in water (e.g. half-life greater than 4 days). Results of this test are tabulated below:

Estuarine/Marine Chronic Toxicity

Surrogate Species	% A.I.	NOEC/LOEC (pptr)	MATC (pptr)	Endpoints Affected	MRID No. Author/Year
Mysid *(Americamysis bahia)*	99	5.3/9.8	7.5	total length and dry weight	43730501 Overman & Wisk/1995
Mysid *(Americamysis bahia)*	99	9/21	13.74	Survivability	40228401/ USEPA/1981
Sheepshead Minnow *(Cyprinodon variegatus)*	99	96/190	72.2	weight and length	418038-06/ Sousa/1991

The guideline requirement (72-4a) is fulfilled (MRID #41803806); (72-4b) is not fulfilled (MRID #43730501 chronic mysid testing is required. The additional testing is not expected to result in a significantly different N(

(4) Aquatic Field Testing and Incidents

Field studies.

• An aquatic pond study conducted in Iowa used Thimet 20G insecticide. The study involved 5 study ponds treated ponds). The treated ponds were situated close to fields treated with phorate so that contaminated wat as a result of natural (rather than simulated) runoff events. A series of rainfall events resulted in a period of ab phorate degradates phorate sulfone and phorate sulfoxide (but not parent phorate) were detectable in pond wa definitive conclusions from the study for reasons that included poor comparability of the physical properties o replication (i.e., few ponds), and high natural variability. A fish kill (i.e., simultaneous death of multiple fish) however, because of the limitations of the study it cannot be used to refute the potential for effects of ecologic

• A mesocosm study in South Dakota investigated the effects of phorate to wetlands macroinvertebrates. Eac and 3 treated mesocosm with application rates of 1.2, 2.4, and 4.8 kg/ha (1, 2, and 4.3 lbs/A), respectively. F resulted in mortality to all amphipods and chironomids (Dieter et al., 1995; MRID No.: 43957801)

Aquatic incidents. The EPA has received several reports of field incidents involving phorate products throu
Monitoring System (PIMS) (See Appendix 2 for table of aquatic incidents).

c. Toxicity to Plants

Currently, *terrestrial plant testing* is not required for granular insecticides. Aquatic plant testing is not requir
insecticides. Supplemental information suggests that technical phorate is not toxic to the marine diatom *Skele*
LC50 of 1.3 ppm (MRID 40228401).